Countering the Tactical UAV Threat

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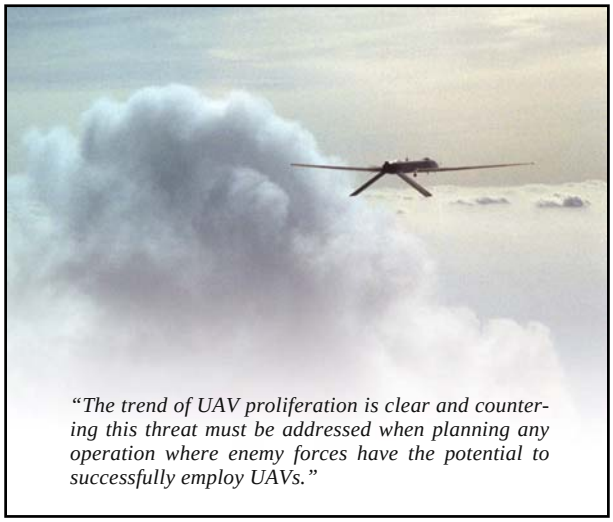

"The trend of UAV proliferation is clear and countering this threat must be addressed when planning any operation where enemy forces have the potential to successfully employ UAVs."

It is Phase II of Operation Urgent Guardian and U.S. Army Ground Forces are operating under an umbrella of air superiority to destroy enemy forces in their assigned areas of operation. An armored task force is conducting a movement to contact at night. At first undetected, an enemy unmanned aerial vehicle (UAV), using its infrared sensors and real-time datalink, relays the unit's location to a terminal at the ground control station (GCS). The GCS immediately sends the coordinates to the fire direction center. The UAV is flying at an altitude of 2500 meters and targeting the task force at a range of 10 km in their direction of travel. Sentinel radar detects the UAV, but due to legacy air defense's existing range limitations, the crew must forward the information to the brigade for action. As Apache attack helicopters are dispatched to intercept and destroy the UAV, dual-purpose improved conventional munitions from an enemy artillery battery barrage the task force. DIVARTY multiple launch rocket system (MLRS) directs successful counterfire against the enemy's artillery, but not before friendly forces sustain substantial casualties.

The U.S. Army Training and Doctrine Command has led the way in thinking about the future characteristics of the Objective Force. In their Objective Force Organization and Operation, they have described a full-spectrum force, organized, manned, equipped, and trained to be more strategically responsive, deployable, agile, versatile, lethal, survivable, and sustainable across the entire spectrum of military operations. We will, "*See First, Understand First, Act First, and Finish Decisively*." This concept describes our ability to maneuver out of contact and strike at a time and place of our choosing. Critical to this concept is our ability to see first.

The Threat

UAVs are aerial vehicles that do not carry a human operator, but can fly autonomously or be piloted remotely and can be either expendable or recoverable. There are two categories of UAVs, drones and remotely piloted vehicles (RPVs). Drones operate autonomously via an onboard computer with the flight plan preprogrammed before launch. As its name suggests, the RPV is remotely piloted via datalink. A UAV system usually consists of one or more aerial vehicles with associated sensor or other types of modular payloads; a GCS, including equipment to control the aerial vehicle and its payload, as well as process data received from it; a ground tracking unit (sometimes collocated with the GCS) for aerial vehicle command, control, and datalink transmissions; and aerial vehicle launch, recovery, and support equipment. UAV missions range from 30 minutes to 5 hours in endurance with an average operational radius of out to 100 km. By 2016, typical UAV endurance will be 24 hours or greater, and the operational radius will increase to greater than 250 km. Current UAV sensor payloads are primarily limited to day only electro-optic (E/O) and limited infrared (IR) capability. The use of daylight E/O, night-capable thermal imaging, and all-weather capable synthetic aperture radar (SAR) will be widespread by 2016. UAVs are currently in more than 50 countries and their effectiveness demonstrates that number is expected to grow to more than 60 by 2016.

Tactical level reconnaissance, surveillance, and target acquisition (RSTA) systems currently dominate UAV inventories, but specialized systems that can perform electronic support/attack and lethal attack missions are emerging and will be typical UAV capabilities in the future. Posed against the Objective Force in the year 2020 and beyond, the adaptive threat using a systemology approach will most likely invest significant resources to produce or acquire UAVs that will locate, designate, attack, and degrade the Objective Force's capabilities. Fighting a highly mobile, lethal, and maneuverable foe, the threat will devote strategic and operational assets to deny unit(s) of employment (UE) access into theater. If unsuccessful, threat commanders will employ tactical UAVs and unmanned combat aerial vehicles (UCAVs) to deny blue force commanders a common operational picture. Moreover, UAV precision munition, electromagnetic pulse, and electronic attacks against command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) will be intended to significantly reduce the blue force's targeting effort, adversely affect blue tempo, and consequently deny the Objective Force the ability to mass the effects of their battlefield functional areas (BFAs).

Countermeasures

In terms of effective current countermeasures against UAVs, there are both passive and active tactics and techniques. UAV countermeasures include employing camouflage, concealment and deception (CCD) techniques; intercepting and destroying the UAV by air- or ground-based fire before it launches or during its flight; destroying the GCS and/or datalink antenna controlling the UAV; jamming the UAV's ground-to-air or air-to-ground datalink signal to its GCS; or intercepting, acquiring, and exploiting the UAV's datalink signal.

Passive Countermeasures

Returning to our original vignette, another task force S2 in the same brigade has determined the threat to have a significant day/night RSTA capability through employment of their UAV systems. Understanding this capability and its effect on friendly maneuver, the S2 recommends passive countermeasures to the TF commander and S3 to disrupt

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Photo courtesy of Raytheon

the enemy's target acquisition process and thus increase unit survivability. Passive countermeasures for night offensive operations against threat UAV infrared sensors include dispersing vehicles, terrain masking movement, using camouflage nets and natural vegetation for concealment, rapid movement across open areas, movement in stages from one natural screen to the next, and using smoke at critical crossings and chokepoints.

Active Countermeasures

At a higher echelon, the division G2, having identified the enemy's center of gravity as their robust and highly effective system of fires (to include chemical delivery), readily understands the importance of the UAVs as a targeting combat multiplier to support the enemy's most probable and most dangerous courses of action. The G2 identifies enemy UAV systems as a high value target and ensures that it is prioritized accordingly in the collection plan, information operations (IO) plan, and the attack guidance matrix.

Assuming that the GCS is within range, field artillery attacks of UAV GCS are a potent countermeasure to UAV operations, but accurate templating and proactive targeting are difficult as launch and GCS sites have few identifying factors. Signal intelligence (SIGINT) provides general localization of a ground station based on the associated signals from the station, but are rarely accurate enough to support fire missions expected to achieve a significant probability of damage to a point target. Harassing fire missions could be conducted with SIGINT as the primary source, but the chances of success would be highly dependent on the discipline of the GCS operators and the perceived density and proximity of munitions impact. In any event, the effect would be temporary and the threat would reappear at some point in the future. In this scenario, with the G2's guidance, the collection manager produces a plan with the necessary redundancy to target the GCS/datalink antenna. SIGINT intercept could be used to cue ground reconnaissance patrols or friendly UAVs to search out the GCS sites and provide accurate targeting data for artillery or aircraft with neutralization or destruction highly probable.

As friendly forces have found the uplink and/or downlink, they are prepared, in accordance with the IO plan, to conduct electronic attacks against the signal. Jamming the UAV's ground-to-air or air-to-ground datalink to its ground control or data terminal station can effect a soft kill by denying the UAV operators command guidance capability and/or downlinked imagery. If the UAV is being operated as an RPV under direct flight control of a remote operator, loss of the command guidance signal can cause a hard kill to the UAV if it has no return-to-home or automatic loiter on loss of datalink signal capability. At the operational level, jamming GPS in the vicinity of operations can affect the UAV's navigational accuracy, but this action would also affect friendly GPS receivers. Another alternative is to intercept and acquire the UAV's datalink signals and use them to either see what the threat system is seeing and determine if it is imaging potential targets, or replicate the signals to surreptitiously insert false return-to-home coordinates, or turn off vital flight control systems.

Finally, destroying a UAV by any means prior to launch is highly challenging, but intercepting the vehicle in flight is feasible if air platforms are available to engage the UAV. Current ground-based air defense systems are less effective against tactical UAVs as RSTA sensors have a standoff of 10 to 20 km to the target. Unless the UAV is vectored to within Stinger range, existing short-range air defense (SHORAD) cannot engage the target. In response to this significant medium-range threat, such as UAVs, UCAVs, and tank-killing attack helicopters, air and missile defense (AMD) forces are now developing a system called surface launched advanced medium range air-to-air missile (SLAMRAAM). This system, combined with Sentinel radar, will proactively protect the force by acquiring and destroying targets, such as UAVs, at a point in the battlespace beyond the enemy's effective use of RSTA sensors. Objective Force AMD will enforce standoff beyond ranges at which UAVs can detect, target, or attack the force.

The evolving UAV threat poses a significant challenge to all ground forces. Of the emerging combat multipliers, UAVs are unique in that their integration with existing systems requires little effort, and relative to other reconnaissance platforms, UAVs are both technologically attainable and affordable. The trend of UAV proliferation is clear and countering this threat must be addressed when planning any operation where enemy forces have the potential to successfully employ UAVs. Looking to the future, as friendly air defense capabilities develop, a battalion-sized unit dependent on passive countermeasures as the primary means to protect the force will be reduced and eventually replaced by air defense's proactive protection such as destroying enemy UAVs at an advantageous point in the friendly battlespace. Proactive protection via AMD forces will provide battlefield commanders with greater freedom of maneuver and will deny the enemy's capability to successfully execute asymmetrical attacks from the third dimension.

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